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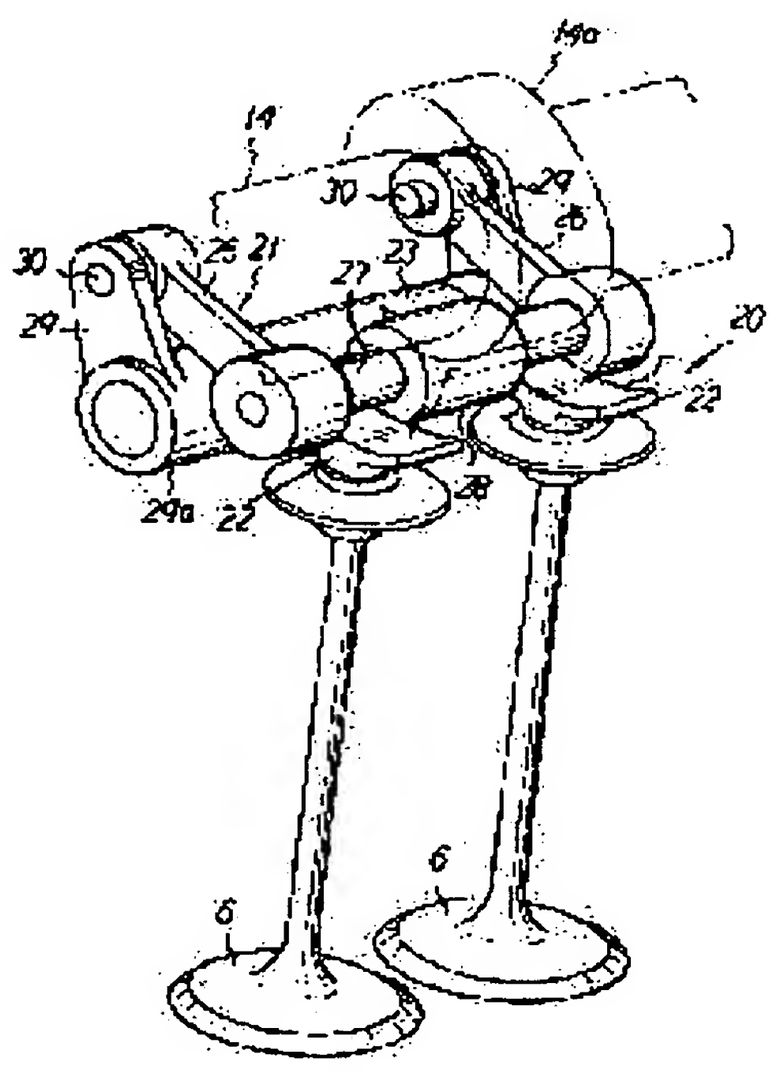
(54) VALVE SYSTEM OF FOUR-CYCLE ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a valve system of a four-cycle engine to provide optimum engine performance by continuously changing a lift amount and the closing timing of a valve through simple constitution.
SOLUTION: In a valve system 20 of a four-cycle engine wherein a valve 6 is opened and closed by transmitting a lift of a cam 14a, formed at a rotationally driven cam shaft 14, to a valve 6 through a locker arm, the locker arm consists of locker arms 21 and 22 in two stages making contact with each other for oscillation and the locker shaft (an oscillation shaft) 30 of at least one locker arm 21 is brought into a displaceable state and a lift amount and the opening and closing timing of the valve 6 are continuously changeable. In this invention, by displacing the locker shaft 30 of at least one (the locker arm 21) of the locker arms 21 and 22 in two stages, a lift amount and the closing timing of the valve 6 are continuously changed, whereby a plurality of cams and switching means are not needed, a need for a complicated mechanism and a variable timing device required for control is also eliminated, and optimum engine performance is obtained through simple constitution.



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CLAIMS

[Claim(s)]
[Claim 1] In the valve gear of the four stroke cycle engine which opens and closes this bulb by transmitting the lift of the cam formed in the cam shaft by which revolution actuation is carried out to a bulb through a rocker arm The valve gear of the four stroke cycle engine characterized by constituting so that displacement of the splash shaft of one [at least] rocker arm may be enabled and the amount of lifts and closing motion timing of a bulb may change continuously, while constituting from two steps of rocker arms which contact mutually and rock said rocker arm.
[Claim 2] The valve gear of the four stroke cycle engine according to claim 1 characterized by making said roller shaft contact said 1st rocker arm while fix the splash shaft of the 1st rocker arm, making this rocker arm contact a bulb, making the 2nd rocker arm which can displace a splash shaft support a roller through a roller shaft, enabling a free revolution and making this roller contact said cam.
[Claim 3] The valve gear of the four stroke cycle engine according to claim 2 characterized by having supported the end of an arm to revolve on the splash shaft of said 1st rocker arm, and supporting the end of said 2nd rocker arm to revolve free [rotation] with a splash shaft to the other end of installation and this arm.
[Claim 4] The valve gear of the four stroke cycle engine according to claim 3 characterized by driving the splash shaft of said 1st rocker arm by the driving means, making said arm rotate to the circumference of this splash shaft center, and carrying out the variation rate of the splash shaft of said 2nd rocker arm.
[Claim 5] The valve gear of the four stroke cycle engine according to claim 2, 3, or 4 characterized by making into the radii curved surface centering on the axial center of said cam shaft the field where said roller shaft of said 1st rocker arm contacts.
[Claim 6] Claims 1-4 characterized by forming adjustable valve timing equipment in said cam shaft, or the valve gear of a four stroke cycle engine given in five.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the valve gear of the four stroke cycle engine which opens and closes this bulb by transmitting the lift of the cam formed in the cam shaft by which revolution actuation is carried out to a bulb through a rocker arm.
[0002]
[Description of the Prior Art] The inlet port and exhaust port which carry out opening to a combustion chamber are opened and closed to respectively suitable timing by the intake valve and the exhaust air bulb, and a necessary gas exchange is made within a cylinder in a four stroke cycle engine.
[0003] By the way, in a four stroke cycle engine, in order to acquire a high charging efficiency, to realize high power, and to secure high combustion efficiency at the time of a low speed and to aim at an improvement of low fuel consumption and an exhaust gas property by promoting the flow of inhalation of air or exhaust air at the time of a high speed, it is necessary to change either or the both sides of one [at least] amount of lifts of an intake valve or an exhaust air bulb, and closing motion timing at the time of a high speed and a low speed.
[0004] Then, as a valve-lift adjustable device, the cam for high speeds and the cam for low speeds are prepared, what changed the amount of lifts of a bulb for the rocker arm which ****s for each cam connection and by carrying out a deconcatenation selectively by the means for switching at the time of a high speed and a low speed is proposed, and practical use is presented.
[0005] Moreover, by changing the angle of rotation of a cam shaft relatively to the angle of rotation of a crankshaft as adjustable valve timing equipment, the thing to which it was made to change the closing motion timing of a bulb at the time of a high speed and a low speed is proposed, and practical use is presented.
[0006]
[Problem(s) to be Solved by the Invention] However, in the conventional valve-lift adjustable device, since two or more cams and means for switching were required about each cylinder, while structure was complicated and causing the cost rise, it was impossible to have changed the amount of valve lifts continuously.
[0007] Moreover, since adjustable valve timing equipment was driven with oil pressure, it required a complicated hydraulic circuit and a complicated oil pressure control, and also it had the problem that the adjustable range of valve timing was inadequate.
[0008] This invention was made in view of the above-mentioned problem, and the place made into the object is to offer the valve gear of the four stroke cycle engine which the amount of lifts and closing motion timing of a bulb can be continuously changed with an easy configuration, and can obtain the optimal engine performance.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned object, invention according to claim 1 In the valve gear of the four stroke cycle engine which opens and closes this bulb by transmitting the lift of the cam formed in the cam shaft by which revolution actuation is carried out to a bulb through a rocker arm While constituting from two steps of rocker arms which contact mutually and rock said rocker arm, it is characterized by constituting so that displacement of the splash shaft of one [at least] rocker arm may be enabled and the amount of lifts and closing motion timing of a bulb may change continuously.
[0010] In invention according to claim 1, it is characterized by making said roller shaft contact said 1st rocker arm while invention according to claim 2 fixes the splash shaft of the 1st rocker arm, makes this

rocker arm contact a bulb, and the 2nd rocker arm which can displace a splash shaft is made to support it for a roller through a roller shaft, enabling a free revolution and it makes this roller contact said cam.
[0011] Invention according to claim 3 is characterized by having supported the end of an arm to revolve on the splash shaft of said 1st rocker arm, and supporting the end of said 2nd rocker arm to revolve free [rotation] with a splash shaft to the other end of installation and this arm in invention according to claim 2.
[0012] In invention according to claim 3, invention according to claim 4 drives the splash shaft of said 1st rocker arm by the driving means, makes said arm rotate to the circumference of this splash shaft center, and is characterized by carrying out the variation rate of the splash shaft of said 2nd rocker arm.
[0013] Invention according to claim 5 is characterized by making into the radii curved surface centering on the axial center of said cam shaft the field where said roller shaft of said 1st rocker arm contacts in invention according to claim 2, 3, or 4.
[0014] Invention according to claim 6 is characterized by forming adjustable valve timing equipment in said cam shaft in invention claims 1-4 or given in five.
[0015] Therefore, since it was made to change continuously the amount of lifts and closing motion timing of a bulb by carrying out the variation rate of one [at least] splash shaft of two steps of rocker arms according to invention according to claim 1 or 2, while two or more cams and means for switching become unnecessary about each cylinder, the adjustable valve timing equipment which requires a complicated device and control also becomes unnecessary, and the optimal engine performance can be obtained with an easy configuration.
[0016] Since the variation rate of the splash shaft of the 2nd rocker arm can be carried out by rotating the splash shaft of the 1st rocker arm by the driving means of a servo motor with easy control, a stepping motor, etc. according to invention according to claim 3 or 4, while the configuration of a valve gear is simplified and a cost cut is achieved, highly precise control is attained.
[0017] According to invention according to claim 5, the field where the roller shaft of the 1st rocker arm contacts is written as the radii curved surface centering on the axial center of a cam shaft, and when a roller shaft moves along this radii curved surface, a fixed clearance is held between a roller peripheral face and a cam shaft base circle.
[0018] According to invention according to claim 6, change of the closing motion timing of a bulb can be offset with adjustable valve timing equipment, and only the amount of valve lifts can be changed, or the change width of face of valve timing can be expanded.
[0019]
[Embodiment of the Invention] The gestalt of operation of this invention is explained based on an accompanying drawing below.
[0020] It is the perspective view of the valve gear important section which drawing of longitudinal section of the cylinder head part of a four stroke cycle engine equipped with the valve gear which drawing 1 requires for this invention, and drawing 2 require for the part plan of this four stroke cycle engine, and drawing 3 requires for this invention.
[0021] Although the four stroke cycle engine 1 shown in drawing 1 and drawing 2 is a multiple cylinder engine for automobiles and not being illustrated, two or more cylinders are installed in the die-length direction (the space perpendicular direction of drawing 1 , longitudinal direction of drawing 2) by the cylinder block of this four stroke cycle engine 1, and the piston is fitted in it free [sliding] into each cylinder. And each piston is connected with the crankshaft through the connecting rod.
[0022] It ** and the cylinder head 2 is put on the top face of the above-mentioned cylinder block, and as shown in drawing 1 , the inhalation-of-air path 3 and every two flueways 4 are formed in this cylinder head 2 about each cylinder, respectively. And inlet port 3a which carries out opening to the combustion chamber 5 of these inhalation-of-air paths 3 and flueways 4, and exhaust port 4a are opened and closed to respectively suitable timing by the intake valve 6 and the exhaust air bulb 7 which are driven by the valve gears 20 and 40 concerning this invention, and a necessary gas exchange is made by this within each cylinder.
[0023] By the way, as the four stroke cycle engine 1 concerning the gestalt of this operation is 4 bulb engine equipped with two intake valves 6 each and exhaust air bulbs 7 about each cylinder and it is shown in drawing 1 Insertion maintenance of the sliding of the valve guides 8 and 9 pressed fit in the cylinder head 2 of each intake valve 6 and the exhaust air bulb 7 is enabled. These are energized at the closing side, respectively with the valve springs 12 and 13 ****(ed) between the bulb retainers 10 and 11 and the cylinder head 2.
[0024] Moreover, as shown in drawing 2 , the air inlet cam shaft 14 and the exhaust cam shaft 15 are

supported by the upper part of the cylinder head 2 mutually in parallel and free [a revolution], and are arranged on it along the die-length direction, and the chain sprockets 16 and 17 are attached in the end which extends from the end side of the cylinder head 2 of these air inlet cam shafts 14 and exhaust cam shafts 15, respectively. In addition, in drawing 2 , 18 is a plug hole which carries out opening between the air inlet cam shaft 14 and the exhaust cam shaft 15 for every cylinder, and insertion screwing of the non-illustrated ignition plug is carried out at this plug hole 18.

[0025] It **, and as mentioned above, although an intake valve 6 and the exhaust air bulb 7 are driven by said valve gears 20 and 40 concerning this invention, the detail of the configuration of the valve gear 20 of the inspired air flow path which drives an intake valve 6 is explained hereafter.

[0026] It is supported up and down free [rotation] with the rocker shaft (splash shaft) 24 which the downward rocker arm 22 is formed one pair of right and left corresponding to [as the valve gear 20 of an inspired air flow path is equipped with the rocker arms 21 and 22 of two steps of upper and lower sides and it is shown in drawing 2 and drawing 3] the number (two) of intake valves 6, and, as for the rocker arm 22 on either side, the end face section is connected with one by the boss section 23, and inserts these in the boss section 23. And the underside of the point of each rocker arm 22 is in contact with the crowning of the valve stem of each intake valve 6 like a graphic display, and the radii curved surface F centering on the axial center of the air inlet cam shaft 14 is formed in the point top face of each rocker arm 22.

[0027] Here, said rocker shaft 24 is supported by the cylinder head 2 rotatable, and the end is connected with the drive motor 25 attached in the end side of the cylinder head 2. In addition, the drive motor 25 is constituted by the servo motor and stepping motor in which highly precise control is possible.

[0028] On the other hand, as the upper rocker arm 21 is shown in drawing 2 and drawing 3 , the center section of the roller shaft 27 constructed between the points of the arm 26 of a left Uichi pair enables insertion support of the revolution of the cylinder-like roller 28, it is constituted, and the peripheral face of a roller 28 is in contact with the peripheral face (cam side) of air inlet cam 14a formed in the air inlet cam shaft 14 for every cylinder at one. Moreover, the part exposed to right and left from the roller 28 of said roller shaft 27 is in contact with the radii curved surface F in which the top face of each of said rocker arm 22 was formed.

[0029] By the way, although insertion maintenance of the boss section 23 of a rocker arm 22 is carried out rotatable as mentioned above at said rocker shaft 24, boss section 29a of each arm 29 of a left Uichi pair is bound to the both sides of the boss section 23 of this rocker shaft 24. Therefore, although each arm 29 rotates the rocker shaft 24 as a core with the rocker shaft 24, the end face section of the arm 26 of each of said rocker arm 21 is connected at the head rotatable with the rocker shaft (splash shaft) 30. Therefore, both the arms 26 and 29 constitute the link mechanism crooked in the shape of [of ********] a character, while was prepared in the end point of both the arms 26 and 29, and the rocker shaft 30 (splash shaft of a rocker arm 21) can displace the rocker shaft 24 (splash shaft of a rocker arm 22) of another side as a core.

[0030] In addition, although the detailed explanation about this is omitted since the configuration of the valve gear 40 of the exhaust side which drives the exhaust air bulb 7 is the same as that of it of the valve gear 20 of an inspired air flow path, this valve gear 40 is also constituted including the rocker arms 41 and 42 which accomplish two steps, the arm 49, and the drive-motor 45 grade. Moreover, exhaust cam shaft 15a is formed in the exhaust cam shaft 15 for every cylinder at one.

[0031] If it **, the four stroke cycle engine 1 concerned starts and revolution actuation of the non-illustrated crankshaft is carried out The revolution is transmitted to the air inlet cam shaft 14 and the exhaust cam shaft 15 through non-illustrated a cam chain and said chain sprockets 16 and 17 (refer to drawing 2). Revolution actuation of these air inlet cam shafts 14 and exhaust cam shafts 15 is carried out at the rate of one half of crankshafts. An intake valve 6 and the exhaust air bulb 7 drive, respectively, and inlet port 3a and exhaust port 4a (refer to drawing 1) are opened and closed to respectively suitable timing by the valve gears 20 and 40 concerning this invention.

[0032] That is, if revolution actuation of the air inlet cam shaft 14 is carried out as mentioned above, the rocker arm 21 equipped with the roller 28 which contacts the peripheral face (cam side) of air inlet cam 14a formed in this air inlet cam shaft 14 will rock the rocker shaft 30 up and down as a core in accordance with the configuration (profile) of air inlet cam 14a. And an intake valve 6 drives, and inlet port 3a is opened [the rocker arm 22 which contacts the roller shaft 27 of this rocker arm 21 rocks the rocker shaft 24 up and down as a core with the splash of the upper and lower sides of this rocker arm 21, and] by the splash of this rocker arm 22 and closed to suitable timing.

[0033] That is, since the lift of air inlet cam 14a is transmitted to a rocker arm 22 through the roller shaft 27 from the roller 28 of a rocker arm 21, it is further transmitted to an intake valve 6 from a rocker arm 22 and

this intake valve 6 is depressed, inlet port 3a is opened.
[0034] Moreover, the exhaust air bulb 7 is also driven by the valve gear 40 of an exhaust side, and exhaust port 4a is opened similarly and closed to suitable timing.
[0035] It **, and according to the valve gears 20 and 40 concerning this invention, the amount of lifts and closing motion timing of an intake valve 6 and the exhaust air bulb 7 can be changed continuously. Here, the working principle of the valve gear 20 of an inspired air flow path is explained based on drawing 4 - drawing 7 . In addition, since the same is said of the working principle of the valve gear 40 of an exhaust side, the explanation about this is omitted.
[0036] A fragmentary sectional view for drawing 4 to explain the working principle of the valve gear 20 of an inspired air flow path, drawing 5 - drawing 7 are drawings showing the amount of lifts of an intake valve 6, and the relation between closing motion timing and a crank angle.
[0037] If it thinks on the basis of the case where the rocker shaft 30 (an axial center is set to Q) of a rocker arm 21 is in the location shown in drawing 4 as a continuous line, at this time, the roller 28 of a rocker arm 21 will also be in a continuous-line location, and the roller shaft 27 will touch in the point S of the radii curved surface F of a rocker arm 22. The amount of lifts and closing motion timing of an intake valve 6 in this normal condition are shown to drawing 5 by Curve a to a crank angle.
[0038] If only a predetermined include angle is turned clockwise, in order that it ** and a drive motor 25 is driven to the above-mentioned reference state, and only whenever [isogonism] may also rotate the arm 29 of drawing 4 bound to this rocker shaft 24 in this direction for the rocker shaft 24 (an axial center (immobilization) is set to R), The rocker shaft 30 rotates the rocker shaft 24 as a core, and moves to the chain-line location of drawing 4 (the axial center of the rocker shaft 30 of this location is made into Q'), and the roller shaft 27 and a roller 28 move it to the chain-line location of drawing 4 along the radii curved surface F of a rocker arm 22. At this time, the point of contact to the radii curved surface F of the rocker arm 22 of the roller shaft 27 moves to point S' from Point S.
[0039] If a roller 28 and the roller shaft 27 move to a chain-line location from the continuous-line location of drawing 4 as mentioned above, since the die length L2 of segment C'R as lever length of a rocker arm 22 will become longer than the die length L1 of the segment CR in a reference state (L2> L1), the amount of lifts of an intake valve 6 (the variation rate of the contacting point P to the intake valve 6 of a rocker arm 22 amount) becomes small to the amount of the same lifts of air inlet cam 14a.
[0040] Moreover, when the hand of cut of the air inlet cam shaft 14 is the direction (clockwise rotation) of R of drawing 4 , since the location of the roller 28 shown with the chain line is located in the upstream to the hand of cut of the air inlet cam shaft 14 rather than the location shown as a continuous line, the closing motion timing of an intake valve 6 becomes early. On the other hand, when the hand of cut of the air inlet cam shaft 14 is the direction (counterclockwise rotation) of L of drawing 4 , since the location of the roller 28 shown with the chain line is located in the downstream to the hand of cut of the air inlet cam shaft 14 rather than the location shown as a continuous line, the closing motion timing of an intake valve 6 becomes conversely late.
[0041] Therefore, it is in the condition which the roller 28 and the roller shaft 27 moved to the chain-line location from the continuous-line location of drawing 4 R> 4, and the amount of lifts and the closing-motion timing of an intake valve 6 in case the hand of cut of the air inlet cam shaft 14 is the direction of R are shown to drawing 5 by Curve b to a crank angle, and the amount of lifts and the closing-motion timing of an intake valve 6 in case the hand of cut of the air inlet cam shaft 14 is the direction of L are shown to drawing 5 by Curve c to a crank angle.
[0042] Therefore, if the rocker shaft 24 is driven and the roller shaft 27 and a roller 28 are moved along the radii curved surface F of a rocker arm 22 with a drive motor 25, the amount of lifts and closing motion timing of an intake valve 6 are continuously changeable.
[0043] Here, when the rocker shaft 24 is driven and the roller shaft 27 and a roller 28 are moved along the radii curved surface F of a rocker arm 22 with a drive motor 25, the amount of lifts and closing motion timing of an intake valve 6 in case ** CRQ=theta shown in drawing 4 is 20 degrees, 30 degrees, 40 degrees, 50 degrees, and 60 degrees are shown in drawing 6 and drawing 7 , respectively about the case where air inlet cam directions of shaft rotation are the direction of R, and the direction of L.
[0044] as shown in drawing 6 and drawing 7 , regardless of the hand of cut of the air inlet cam shaft 14, theta increases the amount of lifts of an intake valve 6 -- it is alike, and follows and increases (that is, a roller 28 moves clockwise the axial center C of the air inlet cam shaft 14 as a core -- alike -- following).
[0045] Moreover, as shown in drawing 6 , when the hand of cut of the air inlet cam shaft 14 is the direction of R, the closing motion timing of an intake valve 6 becomes late with the increment in theta, and as shown

in drawing 7 , when the hand of cut of the air inlet cam shaft 14 is the direction of L, the closing motion timing of an intake valve 6 becomes reverse early with the increment in theta.
[0046] With the gestalt of this operation, as mentioned above, the inside of two steps of rocker arms 21 and 22, Since a roller 28 is moved and it was made to change continuously the amount of lifts and closing motion timing of an intake valve 6 (exhaust air bulb 7) by this by carrying out the variation rate of the rocker shaft 30 of one rocker arm 21, While two or more cams and means for switching become unnecessary about each cylinder which the conventional valve-lift adjustable device had taken, the adjustable valve timing equipment which requires a complicated device and control also becomes unnecessary, and the optimal engine performance can be obtained with an easy configuration. Since the amount of valve lifts can be changed especially continuously, it can become possible to set the amount of valve lifts as the value corresponding to need inspired air volume, the loss horsepower of a valve gear system can be reduced, and improvement in engine power can be aimed at.
[0047] Moreover, in order to always move the contact location of the roller shaft 27 to the radii curved surface F of this rocker arm 22 with the splash of a rocker arm 22 during actuation of a valve gear 20, wear in both contact part is controlled.
[0048] In addition, if the adjustable valve timing equipments 50 and 60 are formed in the edge of the air inlet cam shaft 14 and the exhaust cam shaft 15 at drawing 1 and drawing 2 as the chain line shows, change of the closing motion timing of ** and the exhaust air bulbs 6 and 7 can be offset with these adjustable valve timing equipments 50 and 60, and only the amount of valve lifts can be changed, or the change width of face of valve timing can be expanded.
[0049] Furthermore, in the valve gear 20 concerning this invention (40), since the variation rate of the rocker shaft 30 of a rocker arm 21 can be carried out and a roller 28 can be moved by rotating the rocker shaft 24 of a rocker arm 22 with the drive motors 25 (45), such as a servo motor with easy control, and a stepping motor, while the configuration of a valve gear 20 (40) is simplified and a cost cut is achieved, highly precise control is attained.
[0050] In addition, it sets to the valve gear 20 concerning this invention (40). The field where the roller shaft 27 of a rocker arm 22 contacts is written as the radii curved surface centering on the axial center C of the air inlet cam shaft 14. When the roller shaft 27 moves along this radii curved surface F, between the cam shaft base circles shown in the peripheral face and drawing 4 of a roller 28 by chain-line C', a fixed clearance is always held and the backlash of a valve gear 20 (40) is prevented.
[0051] In addition, although the gestalt of this operation explained the gestalt whose displacement of only the splash shaft (rocker shaft) of one rocker arm was enabled, the effectiveness same also as displacement being possible is acquired in both the splash shafts of both rocker arms.
[0052]
[Effect of the Invention] In the valve gear of the four stroke cycle engine which opens and closes this bulb by transmitting the lift of the cam formed in the cam shaft by which revolution actuation is carried out to a bulb through a rocker arm by the above explanation according to this invention so that clearly While constituting from two steps of rocker arms which contact mutually and rock said rocker arm Since it constituted so that displacement of the splash shaft of one [at least] rocker arm might be enabled and the amount of lifts and closing motion timing of a bulb might change continuously, The amount of lifts and closing motion timing of a bulb are continuously changed with an easy configuration, and the effectiveness that the optimal engine performance can be obtained is acquired.

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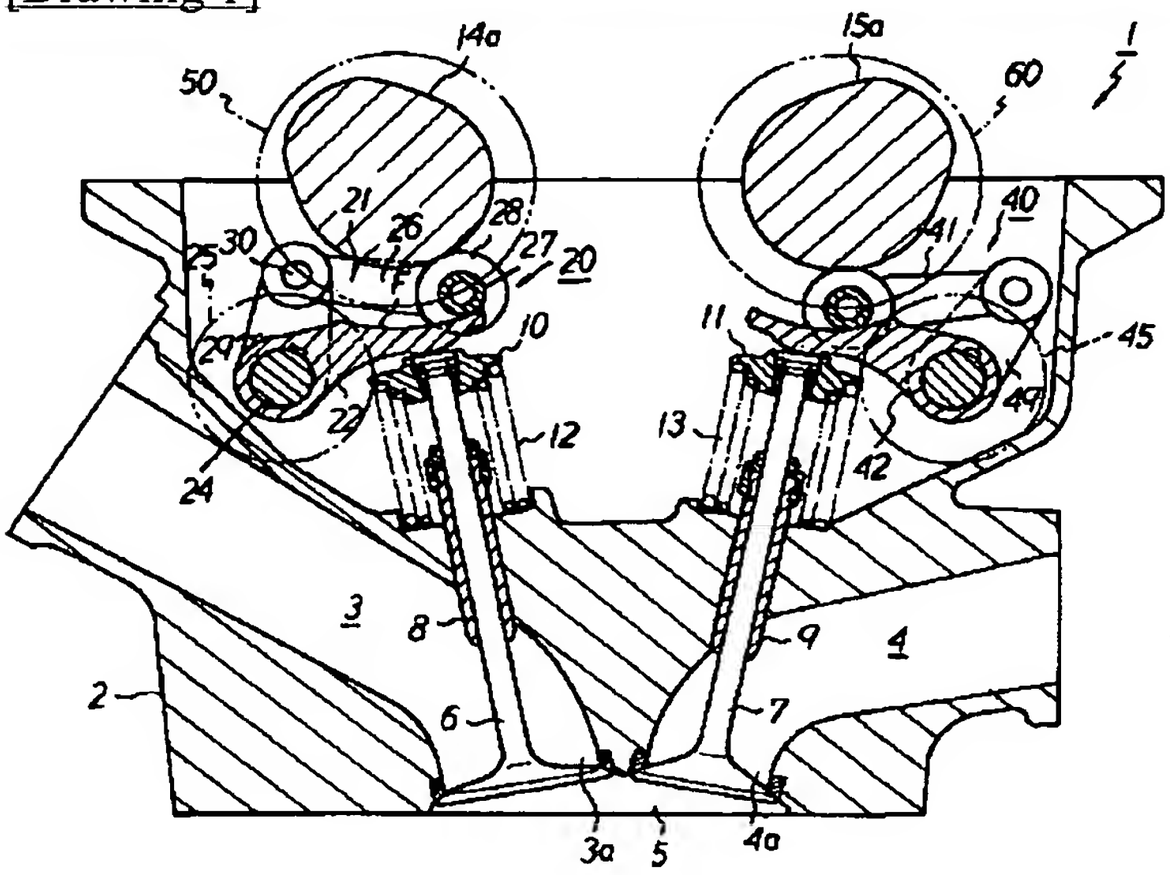
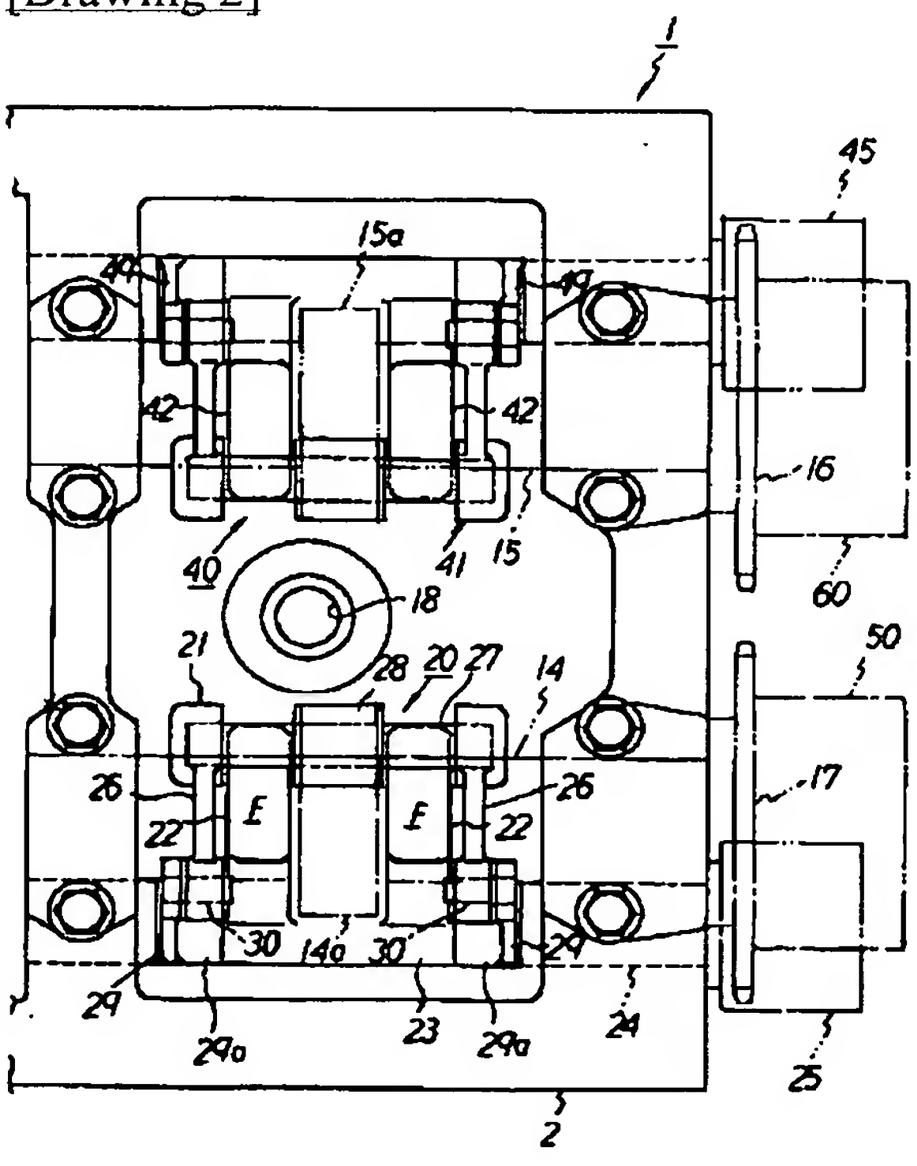
DRAWINGS

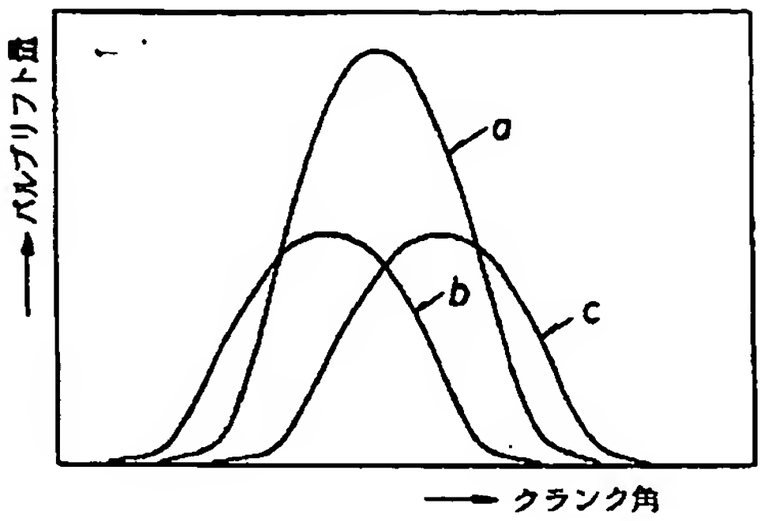
[Drawing 1]



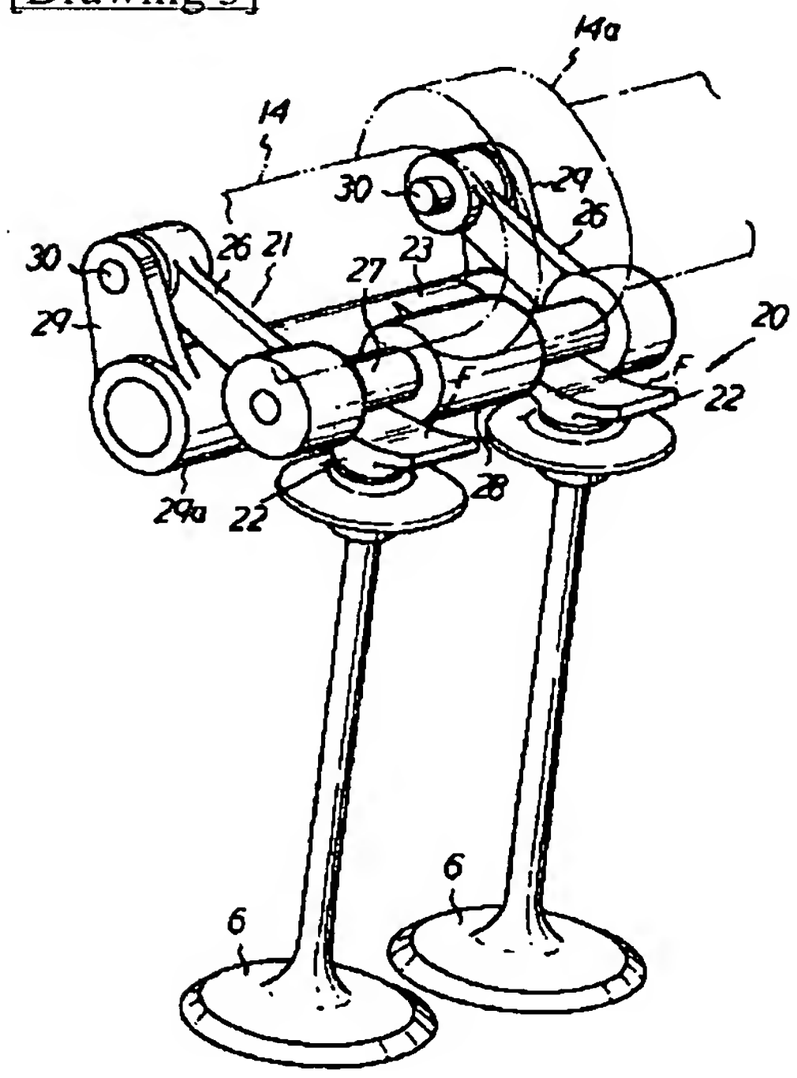
[Drawing 2]



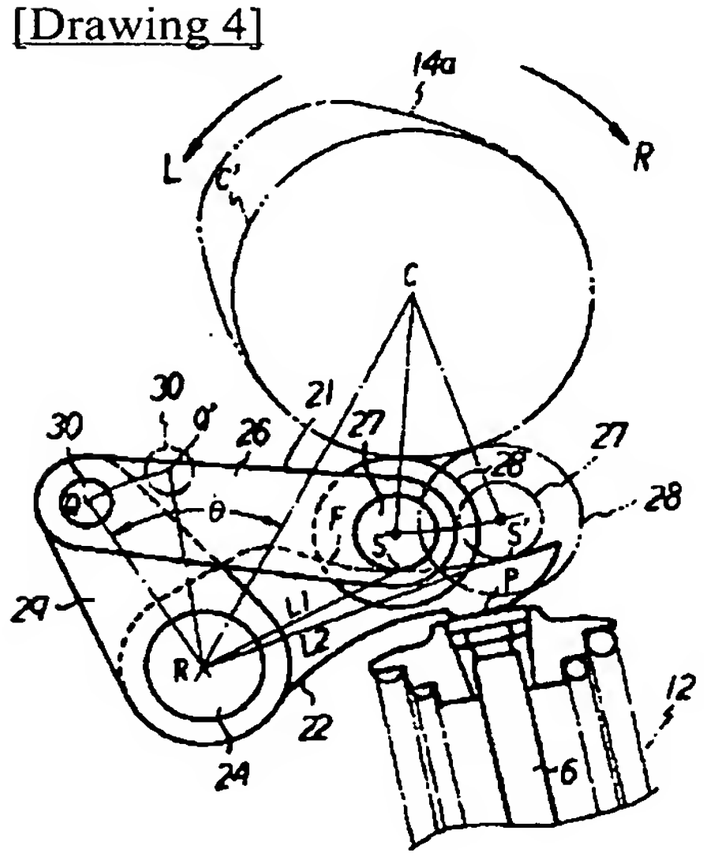
[Drawing 5]



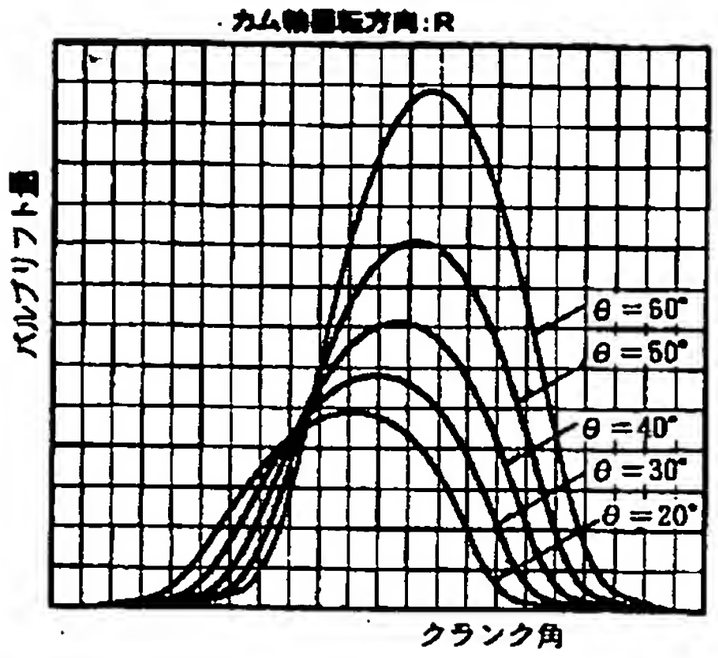
[Drawing 3]



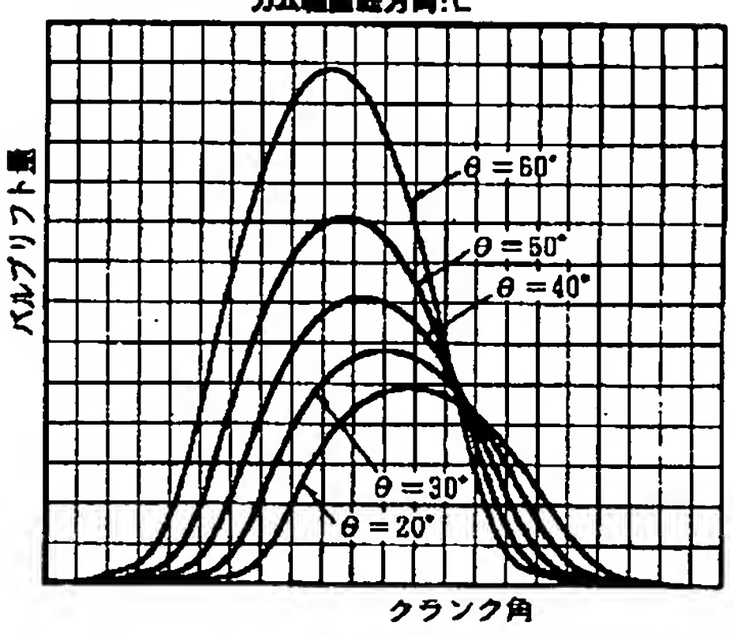
[Drawing 4]



[Drawing 6]



[Drawing 7]



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